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AMENDMENTS TO THE CLAIMS

Following is a complete set of claims as amended with this Response. This complete set of claims excludes cancelled claims 1-3, 21-24, 27 and includes amended claims 4, 5, 8, 11, 13, 15, 17, 19, 25, 26, 28 and new claims 30-33.

1. (Cancelled)

2. (Cancelled)

3. (Cancelled)

4. (Currently Amended) ~~The method of claim 3 further comprising~~ In an implantable cardiac stimulation device having a pulse generator for generating pacing pulses for applying to a heart of a patient and having a control circuit for controlling the pulse generator to apply overdrive pacing pulses to the heart using a set of control parameters, a method, performed by the control circuit, for automatically adjusting the control parameters comprising:

acquiring an initial set of control parameters;

controlling the pulse generator, based on the set of control parameters, to overdrive pace the heart;

determining a degree of overdrive pacing achieved using the selected set of control parameters;

adjusting the set of control parameters so as to improve the degree of overdrive pacing to be achieved during further overdrive pacing;

acquiring a desired overdrive pacing range; and

inputting an order of priority of control parameter adjustment and wherein adjusting the set of control parameters is performed sequentially to hierarchically adjust the control parameters in the input order of priority.

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5. (Currently Amended) The method of claim 3 4 wherein the initial set of control parameters comprises one or more of: a number of overdrive events; an overdrive pacing response function; a recovery rate; a base rate; a rest rate; and a circadian base rate.

6. (Original) The method of claim 5 wherein the number of overdrive events specifies a number of consecutive overdrive beats to be paced following initiation of overdrive pacing.

7. (Original) The method of claim 6 wherein, if the number of overdrive events is to be adjusted, the number of overdrive events is decreased if the detected degree of overdrive pacing exceeds the desired overdrive pacing range and increased if the detected degree of overdrive pacing is below the desired overdrive pacing range.

8. (Currently Amended) The method of claim 5 In an implantable cardiac stimulation device having a pulse generator for generating pacing pulses for applying to a heart of a patient and having a control circuit for controlling the pulse generator to apply overdrive pacing pulses to the heart using a set of control parameters, a method, performed by the control circuit, for automatically adjusting the control parameters comprising:

acquiring an initial set of control parameters;

controlling the pulse generator, based on the set of control parameters, to overdrive pace the heart;

determining a degree of overdrive pacing achieved using the selected set of control parameters; and

adjusting the set of control parameters so as to improve the degree of overdrive pacing to be achieved during further overdrive pacing;

acquiring a desired overdrive pacing range;

wherein adjusting the control parameters to vary the degree of overdrive pacing comprises:

selecting a control parameter to be adjusted;

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comparing the degree of overdrive pacing achieved using the selected set of control parameters with the desired overdrive pacing range;
if the detected degree of overdrive pacing exceeds the desired overdrive pacing range, adjusting the selected control parameter so as to decrease the degree of overdrive pacing; and
if the detected degree of overdrive pacing is below the desired overdrive pacing range, adjusting the selected control parameter so as to increase the degree of overdrive pacing; and

wherein the overdrive pacing response function specifies an overdrive pacing rate to be used for overdrive pacing the heart following initiation of overdrive pacing, with the overdrive pacing rate being dependent upon detected heart rate.

9. (Original) The method of claim 8 wherein the overdrive pacing response function is selected from among a set of overdrive pacing response functions with overdrive pacing rates generally differing from one response function to another.

10. (Original) The method of claim 9 wherein, if the overdrive pacing response function is to be adjusted, an overdrive pacing response function having generally lower overdrive rates is selected if the detected degree of overdrive pacing exceeds the desired overdrive pacing range and an overdrive pacing response function having generally higher overdrive rates is selected if the detected degree of overdrive pacing is below the desired overdrive pacing range.

11. (Currently Amended) The method of claim 5 wherein the recovery rate specifies a rate decrement by which the overdrive pacing rate is decreased after the number of overdrive events have been paced.

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12. (Original) The method of claim 11 wherein, if the recovery rate is to be adjusted, the recovery rate is increased if the detected degree of overdrive pacing exceeds the desired overdrive pacing range and decreased if the detected degree of overdrive pacing is below the desired overdrive pacing range.

13. (Currently Amended) The method of claim 5 in an implantable cardiac stimulation device having a pulse generator for generating pacing pulses for applying to a heart of a patient and having a control circuit for controlling the pulse generator to apply overdrive pacing pulses to the heart using a set of control parameters, a method, performed by the control circuit, for automatically adjusting the control parameters comprising:

acquiring an initial set of control parameters;

controlling the pulse generator, based on the set of control parameters, to overdrive pace the heart;

determining a degree of overdrive pacing achieved using the selected set of control parameters;

adjusting the set of control parameters so as to improve the degree of overdrive pacing to be achieved during further overdrive pacing; and

acquiring a desired overdrive pacing range;

wherein adjusting the control parameters to vary the degree of overdrive pacing comprises:

selecting a control parameter to be adjusted;

comparing the degree of overdrive pacing achieved using the selected set of control parameters with the desired overdrive pacing range;

if the detected degree of overdrive pacing exceeds the desired overdrive pacing range, adjusting the selected control parameter so as to decrease the degree of overdrive pacing; and

if the detected degree of overdrive pacing is below the desired overdrive pacing range, adjusting the selected control parameter so as to increase the degree of overdrive pacing;

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wherein the initial set of control parameters comprises one or more of: a number of overdrive events; an overdrive pacing response function; a recovery rate; a base rate; a rest rate; and a circadian base rate; and

wherein the base rate specifies a minimum non-overdrive pacing rate for use while the patient is awake.

14. (Original) The method of claim 13 wherein, if the base rate is to be adjusted, the base rate is decreased if the detected degree of overdrive pacing exceeds the desired overdrive pacing range and increased if the detected degree of overdrive pacing is below the desired overdrive pacing range.

15. (Currently Amended) The method of claim 5 in an implantable cardiac stimulation device having a pulse generator for generating pacing pulses for applying to a heart of a patient and having a control circuit for controlling the pulse generator to apply overdrive pacing pulses to the heart using a set of control parameters, a method, performed by the control circuit, for automatically adjusting the control parameters comprising:

acquiring an initial set of control parameters;

controlling the pulse generator, based on the set of control parameters, to overdrive pace the heart;

determining a degree of overdrive pacing achieved using the selected set of control parameters;

adjusting the set of control parameters so as to improve the degree of overdrive pacing to be achieved during further overdrive pacing; and

acquiring a desired overdrive pacing range;

wherein adjusting the control parameters to vary the degree of overdrive pacing comprises:

selecting a control parameter to be adjusted;

comparing the degree of overdrive pacing achieved using the selected set of control parameters with the desired overdrive pacing range;

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If the detected degree of overdrive pacing exceeds the desired overdrive pacing range, adjusting the selected control parameter so as to decrease the degree of overdrive pacing; and

If the detected degree of overdrive pacing is below the desired overdrive pacing range, adjusting the selected control parameter so as to increase the degree of overdrive pacing;

wherein the initial set of control parameters comprises one or more of: a number of overdrive events; an overdrive pacing response function; a recovery rate; a base rate; a rest rate; and a circadian base rate; and

wherein rest rate specifies a minimum non-overdrive base rate for use while the patient is at profound rest.

16. (Original) The method of claim 15 wherein, if the rest rate is to be adjusted, the rest rate is decreased if the detected degree of overdrive pacing exceeds the desired overdrive pacing range and increased if the detected degree of overdrive pacing is below the desired overdrive pacing range.

17. (Currently Amended) The method of claim 5 in an implantable cardiac stimulation device having a pulse generator for generating pacing pulses for applying to a heart of a patient and having a control circuit for controlling the pulse generator to apply overdrive pacing pulses to the heart using a set of control parameters, a method, performed by the control circuit, for automatically adjusting the control parameters comprising:

acquiring an initial set of control parameters;

controlling the pulse generator, based on the set of control parameters, to overdrive pace the heart;

determining a degree of overdrive pacing achieved using the selected set of control parameters;

adjusting the set of control parameters so as to improve the degree of overdrive pacing to be achieved during further overdrive pacing; and

acquiring a desired overdrive pacing range;

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wherein adjusting the control parameters to vary the degree of overdrive pacing comprises:

selecting a control parameter to be adjusted;

comparing the degree of overdrive pacing achieved using the selected set of control parameters with the desired overdrive pacing range;

if the detected degree of overdrive pacing exceeds the desired overdrive pacing range, adjusting the selected control parameter so as to decrease the degree of overdrive pacing; and

if the detected degree of overdrive pacing is below the desired overdrive pacing range, adjusting the selected control parameter so as to increase the degree of overdrive pacing;

wherein the initial set of control parameters comprises one or more of: a number of overdrive events; an overdrive pacing response function; a recovery rate; a base rate; a rest rate; and a circadian base rate; and

wherein circadian base rate specifies a minimum non-overdrive base rate set based on an average active heart rate while the patient is awake and based on an average rest heart rate while the patient is at rest.

18. (Original) The method of claim 17 wherein, if the circadian rate is to be adjusted, the circadian rate is decreased if the detected degree of overdrive pacing exceeds the desired overdrive pacing range and increased if the detected degree of overdrive pacing is below the desired overdrive pacing range.

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19. (Currently Amended) The method of claim 1 In an implantable cardiac stimulation device having a pulse generator for generating pacing pulses for applying to a heart of a patient and having a control circuit for controlling the pulse generator to apply overdrive pacing pulses to the heart using a set of control parameters, a method, performed by the control circuit, for automatically adjusting the control parameters comprising:

acquiring an initial set of control parameters;

controlling the pulse generator, based on the set of control parameters, to overdrive pace the heart;

determining a degree of overdrive pacing achieved using the selected set of control parameters;

adjusting the set of control parameters so as to improve the degree of overdrive pacing to be achieved during further overdrive pacing;

wherein determining the degree of overdrive pacing achieved using the selected control parameters comprises:

tracking the heart rate; and

for each of a set of predetermined set of heart rate ranges, determining an overdrive pacing percentage indicative of paced heart beats to total heart beats.

20. (Original) The method of claim 19 wherein tracking the heart rate is performed over a period of 24 to 48 hours.

21. (Cancelled)

22. (Cancelled)

23. (Cancelled)

24. (Cancelled)

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25. (Currently Amended) The device of claim 24 An implantable cardiac stimulation device comprising:

a pulse generator that is operative to generate pacing pulses to be applied to a heart of a patient; and

a control circuit that is operative to control the pulse generator to apply overdrive pacing pulses to the heart using a set of control parameters and for dynamically and automatically adjusting the control parameters so that a degree of overdrive pacing exceeds a predefined threshold;

wherein the control circuit comprises an overdrive pacing unit operative to input an initial set of control parameters;

control the pulse generator, based on the set of control parameters, to overdrive pace the heart;

determine the degree of overdrive pacing achieved using the selected set of control parameters; and

adjust the set of control parameters so as to improve the degree of overdrive pacing to be achieved during further overdrive pacing;

wherein the overdrive pacing unit also inputs a desired overdrive pacing range;

wherein the overdrive pacing unit adjusts the control parameters to vary the degree of overdrive pacing by selecting a control parameter to be adjusted, comparing the degree of overdrive pacing achieved using the selected set of control parameters with the desired overdrive pacing range, adjusting the selected control parameter so as to decrease the degree of overdrive pacing if the detected degree of overdrive pacing exceeds the desired overdrive pacing range, and adjusting the selected control parameter so as to increase the degree of overdrive pacing if the detected degree of overdrive pacing is below the desired overdrive pacing range; and

wherein the overdrive pacing unit also inputs an order of priority for control parameter adjustment and adjusts the set of control parameters sequentially in the input order of priority to hierarchically adjust the control parameters.

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26. (Currently Amended) The device of claim 24 25 wherein the initial set of control parameters input by the control circuit comprises one or more of: a number of overdrive events; an overdrive pacing response function; a recovery rate; a base rate; a rest rate; and a circadian base rate.

27. (Cancelled)

28. (Currently Amended) ~~The device of claim 27~~ An implantable cardiac stimulation device comprising:

means for generating pacing pulses for applying to the heart of a patient;

means for acquiring an initial set of control parameters for use in overdrive pacing the heart;

means for controlling the means for generating pulses, based on the initial set of control parameters, to overdrive pace the heart;

means for determining the degree of overdrive pacing achieved using the initial set of control parameters; and

means for adjusting the initial set of control parameters so as to improve the degree of overdrive pacing to be achieved during further overdrive pacing;

wherein the means for adjusting the control parameters to vary the degree of overdrive pacing comprises:

means for selecting a control parameter to be adjusted

means for comparing the degree of overdrive pacing achieved using the selected set of control parameters with the desired overdrive pacing range;

means, responsive to a determination that the detected degree of overdrive pacing exceeds the desired overdrive pacing range, for adjusting the selected control parameter so as to decrease the degree of overdrive pacing; and

means, responsive to a determination that the detected degree of overdrive pacing is below the desired overdrive pacing range, for adjusting the selected control parameter so as to increase the degree of overdrive pacing.

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29. (Withdrawn) In an implantable cardiac stimulation device, a method comprising:

 pacing a heart at an overdrive pacing rate specified by a set of control parameters;

 determining whether a degree of overdrive pacing achieved using the set of control parameters falls below a threshold;

 adjusting one or more of the control parameters if the degree of overdrive pacing falls below the threshold; and

 using the adjusted set of control parameters for further overdrive pacing.

30. (New) In an implantable cardiac stimulation device having a pulse generator for generating pacing pulses for applying to a heart of a patient and having a control circuit for controlling the pulse generator to apply overdrive pacing pulses to the heart using a set of control parameters, a method, performed by the control circuit, for automatically adjusting the control parameters comprising:

 acquiring an initial set of control parameters;

 controlling the pulse generator based on the set of control parameters, to overdrive pace the heart;

 determining a degree of overdrive pacing achieved using the selected set of control parameters;

 inputting an order of priority of control parameter adjustment; and

 adjusting the set of control parameters according to the order of priority of control parameter adjustment so as to improve the degree of overdrive pacing to be achieved during further overdrive pacing;

 wherein adjusting the set of control parameters is performed sequentially to hierarchically adjust the control parameters in the input order of priority.

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31. (New) In an implantable cardiac stimulation device having a pulse generator for generating pacing pulses for applying to a heart of a patient and having a control circuit for controlling the pulse generator to apply overdrive pacing pulses to the heart using a set of control parameters, a method, performed by the control circuit, for automatically adjusting the control parameters comprising:

acquiring an initial set of control parameters;

controlling the pulse generator, based on the set of control parameters, to overdrive pace the heart;

determining a degree of overdrive pacing achieved using the selected set of control parameters; and

adjusting the set of control parameters so as to improve the degree of overdrive pacing to be achieved during further overdrive pacing;

wherein the initial set of control parameters has a rest rate to specify a minimum non-overdrive base rate for use while the patient is at profound rest; and

wherein, if the rest rate is to be adjusted, the rest rate is decreased if the detected degree of overdrive pacing exceeds the desired overdrive pacing range and increased if the detected degree of overdrive pacing is below the desired overdrive pacing range.

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32. (New) In an implantable cardiac stimulation device having a pulse generator for generating pacing pulses for applying to a heart of a patient and having a control circuit for controlling the pulse generator to apply overdrive pacing pulses to the heart using a set of control parameters, a method, performed by the control circuit, for automatically adjusting the control parameters comprising:

acquiring an initial set of control parameters;

controlling the pulse generator, based on the set of control parameters, to overdrive pace the heart;

determining a degree of overdrive pacing achieved using the selected set of control parameters; and

adjusting the set of control parameters so as to improve the degree of overdrive pacing to be achieved during further overdrive pacing;

wherein the initial set of control parameters has a circadian base rate to specify a minimum non-overdrive base rate set based on an average active heart rate while the patient is awake and based on an average rest heart rate while the patient is at rest.

33. (New) An implantable cardiac stimulation device comprising:

a pulse generator that is operative to generate pacing pulses to be applied to a heart of a patient;

a control circuit that is operative to control the pulse generator to apply overdrive pacing pulses to the heart using a set of control parameters and for dynamically and automatically adjusting the control parameters so that a degree of overdrive pacing exceeds a predefined threshold; and

an overdrive pacing unit to input an order of priority for control parameter adjustment and to adjust the set of control parameters sequentially in the input order of priority to hierarchically adjust the control parameters.

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